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DOI: https://doi.org/10.5430/afr.v3n1p85

Originally published at:
Barone-Adesi, Giovanni; Farkas, Walter; Koch-Medina, Pablo (2014). Capital levels and risk-taking propensity in financial institutions. Accounting and Finance Research, 3(1):85-89.
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Capital Levels and Risk-Taking Propensity in Financial Institutions

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Received: January 17, 2014 Accepted: February 3, 2014 Online Published: February 16, 2014

doi:10.5430/afr.v3n1p85 URL: http://dx.doi.org/10.5430/afr.v3n1p85

Partial support through the SNF project 51NF40-144611 "Capital adequacy, valuation, and portfolio selection for insurance companies" is gratefully acknowledged.

Part of this research was supported by Swiss Re.

Abstract

Regulators dedicate much attention to a financial institution's option to default, i.e. the option that distressed financial institutions have to transfer losses to their creditors. It is generally recognized that the existence of this option provides intermediaries with a powerful incentive to keep firm capital close to the minimal requirement. We argue, however, that undercapitalization harms profitable growth opportunities, i.e. the institution's franchise value. Indeed, the capitalization of a financial institution will be ultimately driven by the net impact of capital levels on the default option and the franchise value. By considering the impact of the default option, our work complements and extends, within a simple Black-Scholes framework, the model used by Froot and Stein (1998) in the context of banks and by Froot (2007) in the context of insurance.

Keywords: Risk propensity, Net tangible value, Default option, Franchise value

JEL classification: G 31, G 32, G 18

1. Introduction

In this paper we consider the incentives that drive a financial institution's target capitalization levels. Our focus is on the tradeoff between targeting minimum capital levels to increase the value of the option to default and targeting high capital levels to protect the franchise value of the institution.

The value of risky debt under limited liability is bounded by the value of a firm's assets, as described in Black and Scholes (1973). Lower equity values or riskier assets increase the risk of debt, to the detriment of creditors and the benefit of equity holders. These effects are usually very important for financial institutions, because they operate with high leverage.

Managers, acting on behalf of shareholders, may exploit these effects on existing or newly issued debt. They may in fact transfer wealth from bondholders by increasing the risk of debt in place. By acting this way, they maximize the value of the default option, held by shareholders. In the case of institutions that are deemed too important to fail, shareholders benefit by an increase in risk even of new debt. Bondholders do not lose wealth in this case, because their potential loss is covered by the public guarantee.

Financial regulation prescribes minimal capital requirements to control the above incentives by limiting risk-taking that would destabilize markets if left unchecked. In either of the above cases, the default option provides managers with a powerful incentive to expropriate creditors on behalf of shareholders. Therefore, competitive forces will motivate managers to choose minimum capital levels and maximum risk in order to maximize the value of the default put that accrues to shareholders.

The maximization of the default put may however jeopardize the ability of institutions to exploit their growth opportunities, or franchise, because it leaves them undercapitalized. Lower capital levels increase the probability of failure, which would force abandonment of growth opportunities. The sale of these opportunities to third parties from an institution in distress is often difficult. In fact, for simplicity, in this paper we will assume that there is no secondary market for the sale of growth opportunities. Hence, franchise value is completely lost in case of default. Thus, in contrast to the default option, the existence of a franchise value provides incentives for prudent risk taking. As a result, the propensity of the firm toward risk-taking is shaped by the interplay of the default and the growth option, which induces firms to seek or avert risk.

We illustrate, using a simple Black-Scholes based model, the impact the interplay of the default and the growth option has on the capitalization decision and we draw some policy implications. By considering the impact of the default option, our work complements and extends, within this simple Black-Scholes framework, the model used by Froot and Stein (1998) in the context of banks and by Froot (2007) in the context of insurance.

2. Components of the company value

We work in a continuous time setting with initial date $t = 0$ and terminal date $t = T$. We will however consider a financial intermediary who, at time $t = 0$ has a portfolio of assets and liabilities which remains unchanged until time T, and who can exploit positive net present value investment opportunities at time $t = T$. The assets of the intermediary have a value $A(t)$ at time $t \in [0,T]$, its liabilities have face value L and are payable at maturity T. For simplicity, we assume that L is not random. We will assume that the value of assets at time t is given by

$$A(t) = A(0)\exp(\mu t - \frac{\sigma^2}{2}t + \sigma B_t), \tag{1}$$

where $(B_t)_t$ is a standard Brownian motion. Hence, $\log(A(t))$ evolves like a Brownian motion with drift $\mu t - \frac{\sigma^2}{2}t$ and volatility σ. We will assume the risk-free rate is equal to zero. In particular, at any time the risk-free value of L is equal to L.

Similar to Babbel and Merril (2005) in the context of insurance companies, we split the value of the financial intermediary into three components: the net tangible value, the value of the shareholder's option to default and the franchise value. Since we assume limited liability, the value of equity of the financial institution at time T is given by the random variable

$$E(T) := \max\{A(T) - L, 0\}. \tag{2}$$

For our analysis it is convenient to split the value of equity of the financial institution at time T into the two components

$$E(T) := X(T) + D(T), \tag{3}$$

where

$$X(T) := A(T) - L \tag{4}$$

is the *net tangible value* of the institution and

$$D(T) := X^-(T) := \max\{-X(T), 0\} = \max\{L - A(T), 0\} \tag{5}$$

is the shareholder's *option to default*. The random variable $X(T)$ represents the market value of assets less the present value of liabilities without taking the limited liability of the institution into account. Through the default option we recapture the impact of the limited liability of shareholders.

So far, the value of the company captured by $E(T)$ does not include the value associated with the ability of the institution to invest in value creating opportunities at time T. To capture this omission we introduce the variable $F(T)$ describing the net present value of such future "growth" opportunities, i.e. its *franchise value*. Hence, the market value of the company at time T, which we denote by $V(T)$, is given by

$$V(T) = X(T) + D(T) + F(T). \tag{6}$$

While we assume that the financial institution can only default at time $t = T$, we will assume that the franchise disappears as soon as its liabilities exceed its assets at any time between $t = 0$ and $t = T$. Although this assumption is a simplification, it is partly justified because the ability of the firm to acquire profitable new business may be impaired if it is perceived as having a weak financial position before $t = T$. We will consider the situation where the franchise value $F(T)$ is correlated with the value $A(T)$ of the assets.

3. The default option

Recalling that the risk-free rate is assumed to be zero, the default option value ($D(0)$) at time $t = 0$ is then

$$D(0) = L \cdot N\left(\tfrac{1}{2}\sigma^2 T - \frac{\ln(\frac{A(0)}{L})}{\sigma\sqrt{T}} \right) - A(0) \cdot N\left(\frac{-\tfrac{1}{2}\sigma^2 T - \ln(\frac{A(0)}{L})}{\sigma\sqrt{T}} \right) \tag{7}$$

where N is the cumulative normal distribution function and its arguments, given by Black and Scholes, are functions of $A(0)$, L, the risk free rate r, the time to maturity T and the asset volatility σ.

The first row of Table 1, where the franchise value is set to zero, reports the values of the default put for a firm with $A(0)$ ranging from 1000 to 1500, L = 1000, r = 0, T = 1 year and volatility 0.20. The put is a convex decreasing function of the asset value.

Table 2. $D(0) + F(0)$ as function of assets and growth potential

	A = 1000	1100	1200	1300	1400	1500
F = 0	79.655	42.920	21.472	10.088	4.500	1.924
F = 100	79.655	63.969	59.499	61.639	66.726	72.520
F = 300	79.655	106.069	135.559	164.740	191.178	213.71

Ignoring the franchise value, the value of the company is equal to the value $E(0)$ of equity at time $t = 0$:

$$E(0) = A(0) - L + D(0) \tag{8}$$

Note that $A(0) - L$ is independent of asset volatility while $D(0)$ is not. Hence, shareholders and managers acting in their behalf have an incentive to maximize the value of the default option or, equivalently, minimize the value of debt. This can be accomplished, for debt already issued, by increasing volatility. New risky debt would be generally priced by the market on the basis of parameter expectations.

An important exception is the case of institutions deemed to benefit from an implicit public guarantee, such as “too big to fail”. Equation (8) still represents the equity value for these institutions. However, the debt is now effectively riskless. The put value is provided by the public guarantee, which is a subsidy to shareholders. Monitoring by regulators is then necessary to limit the value of this guarantee and prevent intermediaries from destabilizing markets through aggressive undercapitalization. Intermediaries, however, have a strong incentive to game the system, reducing capital levels as much as possible. Gaming will be exacerbated by the differences between regulatory capital, defined by a necessarily rigid set of rules, and economic capital, which is often hard to measure.

4. Franchise

Let now the intermediary have a portfolio of growth opportunities at moment T with positive net present value $F(T)$, which is assumed to follow the same dynamics as A. At earlier dates A comprises the expected value of $F(T)$, that is the franchise value given by a down-and-out call (DOC) option

$$DOC(F(0), A(0), L) = F(0) \cdot \left[N\left(\frac{\ln(\frac{A(0)}{L}) + \tfrac{1}{2}\sigma^2 T}{\sigma\sqrt{T}} \right) - \frac{L}{A(0)} \cdot N\left(\frac{\ln(\frac{L}{A(0)}) + \tfrac{1}{2}\sigma^2 T}{\sigma\sqrt{T}} \right) \right] \tag{9}$$

where the expression on the right is the product of the value of potential growth at time $t = 0$ assuming survival of the firm, $F(0)$, times the “pricing” probability that the intermediary will survive long enough for the growth opportunities to come to fruition. In equation (9) the option DOC is defined to be part of A to focus on the survival probability (the complement of the default probability).

This way we remove the effect of the increasing probability of successful growth on the value of assets. Of course the option DOC should be added to A, providing a greater incentive, if we were to define A as tangible assets only. Equation (9) is derived from the standard DOC option formula in the Black-Scholes framework (Merton, 1973), taking into account that we have set the risk-free rate to zero. The *strike price is also set to zero*, because $F(T)$ represents the present value of growth opportunities net of investment costs.

The franchise value is monotonically increasing in the distance to default, A/L. Its value at zero capital, $A = L$, is zero, its upper bound is $F(T)$ at $A = \infty$. Therefore it is not a convex function of capital. *The franchise value provides an incentive to prudent management*, because we assume that $F(T)$ cannot be sold at its fair value in case of distress.

5. Risk propensity and policy implications

Financial intermediaries in our framework face the default option, which provides an incentive to reckless behavior, as well as the franchise option, which provides an incentive to prudent behavior to pursue growth.

The sum of the values of the two options, with the parameters introduced above, is reported in Table 1, where L is kept constant at 1000, while $F(T)$ and A vary across rows and columns respectively. The sum of the two options equals the default put in the first column, because the probability of touching the default barrier is one if $A = L$. The default put is decreasing with increasing asset values.

The second row shows that the sum of the two options reaches a minimum for a value of assets close to 1200. On the left of minimum, value maximization provides an incentive for capital reduction. On the right of the minimum the firm has an incentive to be well-capitalized, because the franchise option prevails. For values of $F(T)$ greater than 200 the total value of the two options becomes monotonically increasing with assets. The option value is then always maximized by increasing assets. The third row reports the sum of the two option values for $F(T) = 300$.

The franchise option plays a fundamental role in shaping the risk appetite of financial intermediaries. It provides a natural counterbalance to the default put, and leads to a market-based solution to risk-seeking behavior in the financial industry. Rational risk-seeking is limited to firms that do not have a significant portfolio of profitable growth opportunities. These firms have an incentive to hold very little capital and bypass regulation whenever feasible. Other firms find the pursuit of stability more profitable because it improves their franchise value.

For stability to prevail it is fundamental that firms without significant franchise value be removed from financial markets through mergers or liquidation. In fact their strategy to create value for their shareholders must rely only on the exploitation of the public guarantee, through risk seeking. These firms may actually destroy shareholder value by accepting small projects with positive net present value, which may require upfront investments that may not be recovered. Regulatory forbearance is unlikely to lead to positive outcomes under these circumstances.

Capital requirements play a critical role when the sum of the two options is not a monotone function of capital. This case is depicted in the second row of Table 1. Regulators should require capital to the right of the minimum for the growth incentive to prevail. Otherwise these firms will find that the default put provides a greater incentive.

Our results are consistent with capital buffer theory, see Calomiris and Kahn (1991) and Diamond and Rajan (2000), which stipulates that banks do not hold the minimum allowable amount of capital, rather, they have their own preferred target level of capitalization. Also Furlong and Keeley (1989) find that, for a value-maximizing bank, incentives to increase asset risk decline as its capital increases. We note that our results are also consistent with the empirical finding that profitable institutions tend to be well capitalized, even in the presence of deposit insurance; see for instance Berger (1995), Demirgúç and Huizinga (1999), Staikouras and Wood (2004), Goddard, Molyneux and Wilson (2004), Graf (2011), and Jokipii and Milne (2011). The reason is that profitable financial institutions will have a high franchise which is worth protecting by targeting high capital levels.

Hence, firms with significant franchise values self-regulate. They willingly choose limited leverage and volatility. That makes their identification in the market place obvious. Regulation for these firms is mostly crucial at the macro-prudential level. Price or credit bubbles may inflate or destroy the franchise value of these firms, undermining financial stability.

6. Conclusions and future work

The risk appetite of financial intermediaries is determined by the interplay of default and growth opportunities. The role capital plays in these opportunities has been highlighted through the modeling of the franchise value as an option that counteracts the well-known default put.

Intermediaries with high franchise value will choose high capitalization levels voluntarily, a fact that is confirmed by empirical findings. Intermediaries with low franchise values generate instability and are unlikely to change.

We believe that the franchise value, as well as the value of the default option, can be estimated from security prices and accounting information. The choice of the appropriate estimation methods is left to future work.

References

Babbel, D. F., & Merril, C. (2005). Real and illusory value creation by insurance companies. *Journal of Risk and Insurance*, *72*(1), 1-21. http://dx.doi.org/10.1111/j.0022-4367.2005.00113.x

Berger, A. N. (1995). The relationship between capital and earnings in banking. *Journal of Money, Credit and Banking*, *27*(2), 432-456. http://dx.doi.org/10.2307/2077877

Black, F., & Scholes, M. (1973). The Pricing of Options and Corporate Liabilities. *Journal of Political Economy*, *81*(3), 637-654. http://dx.doi.org/10.1086/260062

Calomiris, C. W., & Kahn, C. M. (1991). The role of demandable debt in structuring optimal banking arrangements. *American Economic Review*, *81*(3), 497-513.

Demirgúç, A., & Huizinga, H. (1999). Determinants of commercial bank interest rate margins and profitability: some international evidence. *The World Bank Economic Review*, *13*(2), 379-408. http://dx.doi.org/10.1596/1813-9450-1900

Diamond, D. W., & Rajan, R. (2000). A theory of bank capital. *The Journal of Finance*, *55*(6), 2431-2465. http://dx.doi.org/10.1111/0022-1082.00296

Froot, K. A., Scharfstein, D. S., & Stein, J. C. (1993). Risk management: Coordinating corporate investment and financing policies. *The Journal of Finance*, *48*(5), 1629-1658.

Froot, K. A., & Stein, J. C. (1998). Risk management, capital budgeting, and capital structure policy for financial institutions: an integrated approach. *The Journal of Financial Economics*, *47*(1), 55-82.

Froot, K. A. (2007). Risk management, capital budgeting, and capital structure policy for insurers and reinsurers. *The Journal of Risk and Insurance*, *74*(2), 273-299. http://dx.doi.org/10.1111/j.1539-6975.2007.00213.x

Furlong, F., & Keeley, M. C. (1989). Capital regulation and bank risk-taking: a note. *Journal of Banking and Finance*, *13*(6), 883-891. http://dx.doi.org/10.1016/0378-4266(89)90008-3

Gneiting, T. (2011). Making and evaluating point forecasts. *Journal of the American Statistical Association*, *106*(494), 746-762. http://dx.doi.org/10.1198/jasa.2011.r10138

Goddard, J., Molyneux, Ph., & Wilson, J. O. S. (2004). The profitability of European banks: a cross-sectional and dynamic panel analysis. *The Manchester School*, *72*(3), 363-381. http://dx.doi.org/10.1111/j.1467-9957.2004.00397.x

Graf, F. (2011). Leverage, profitability and risks of banks: an empirical study. *Working paper*.

Jokipii, T., & Milne, A. (2011). Bank capital buffer and risk adjustment decisions. *Journal of Financial Stability*, *7*(3), 165-178. http://dx.doi.org/10.1016/j.jfs.2010.02.002

Merton, R. (1973). Theory of rational option pricing. *Bell Journal of Economics and Management*, *4*(1), 141-183. http://dx.doi.org/10.2307/3003143

Staikouras, Ch. K., & Wood, G. E. (2004). The determinants of European bank profitability. *International Business & Economics Research Journal*, *3*(6), 57-68.